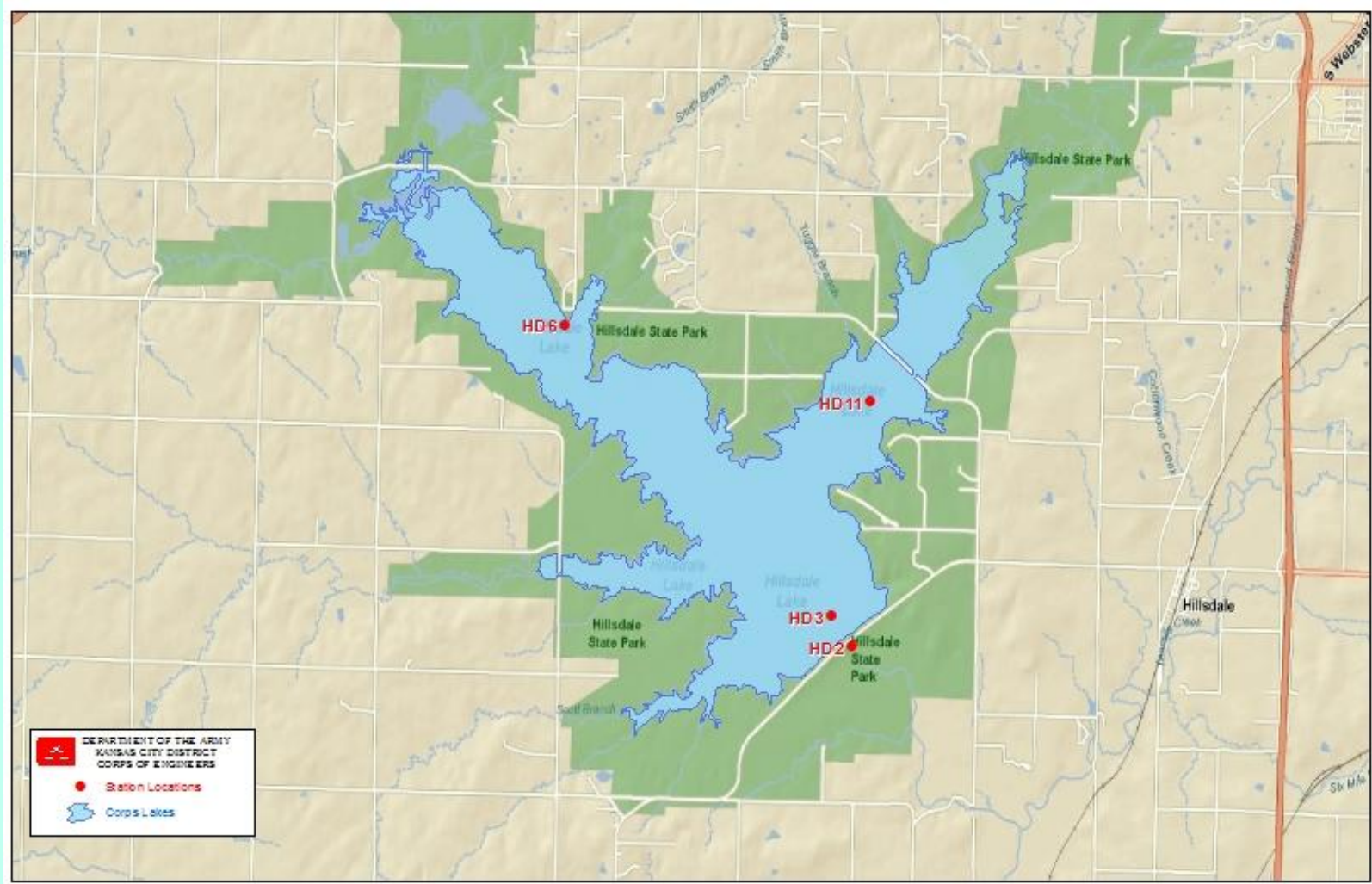


Hillsdale Lake Water Quality Summary

2003-2012

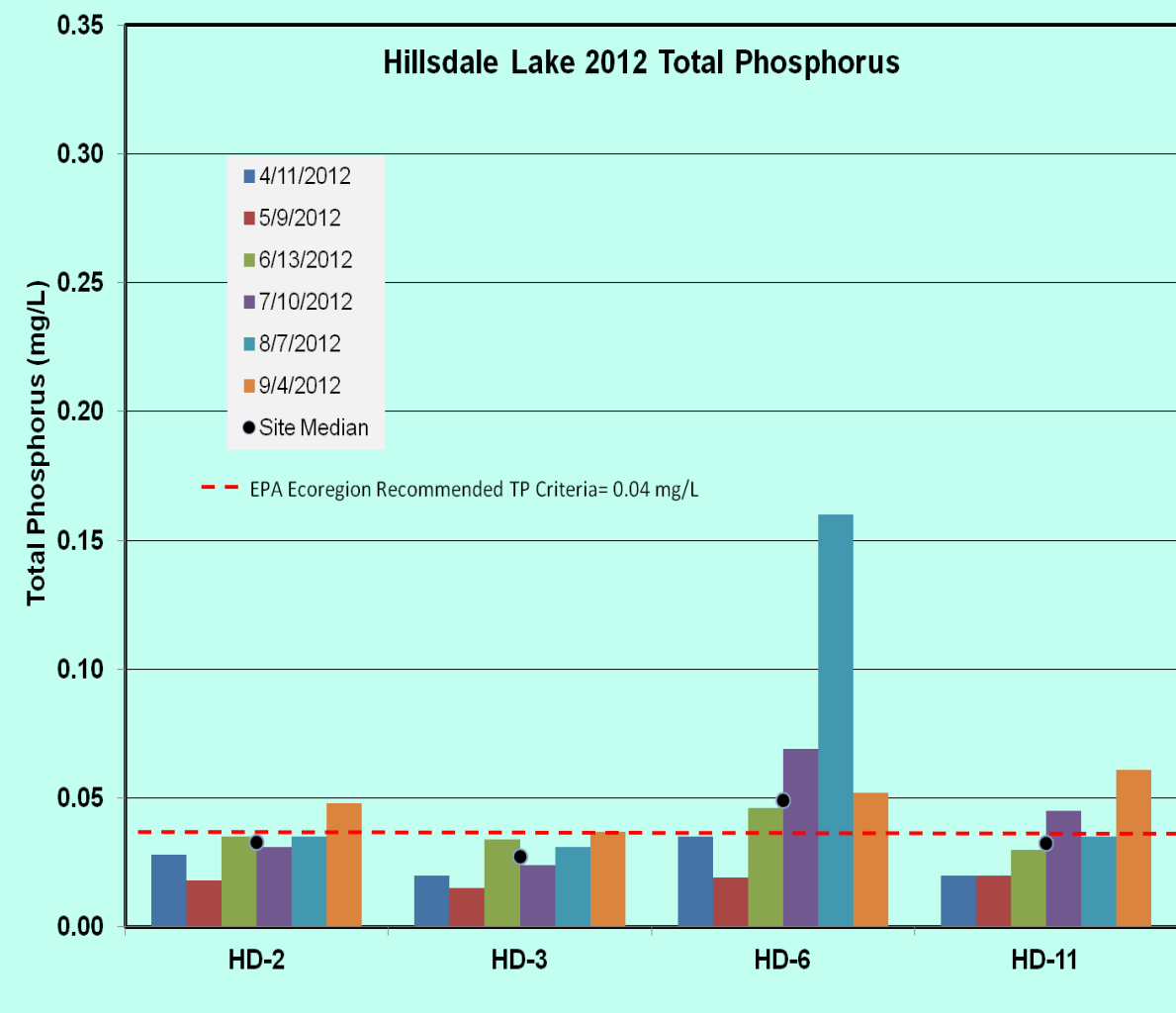
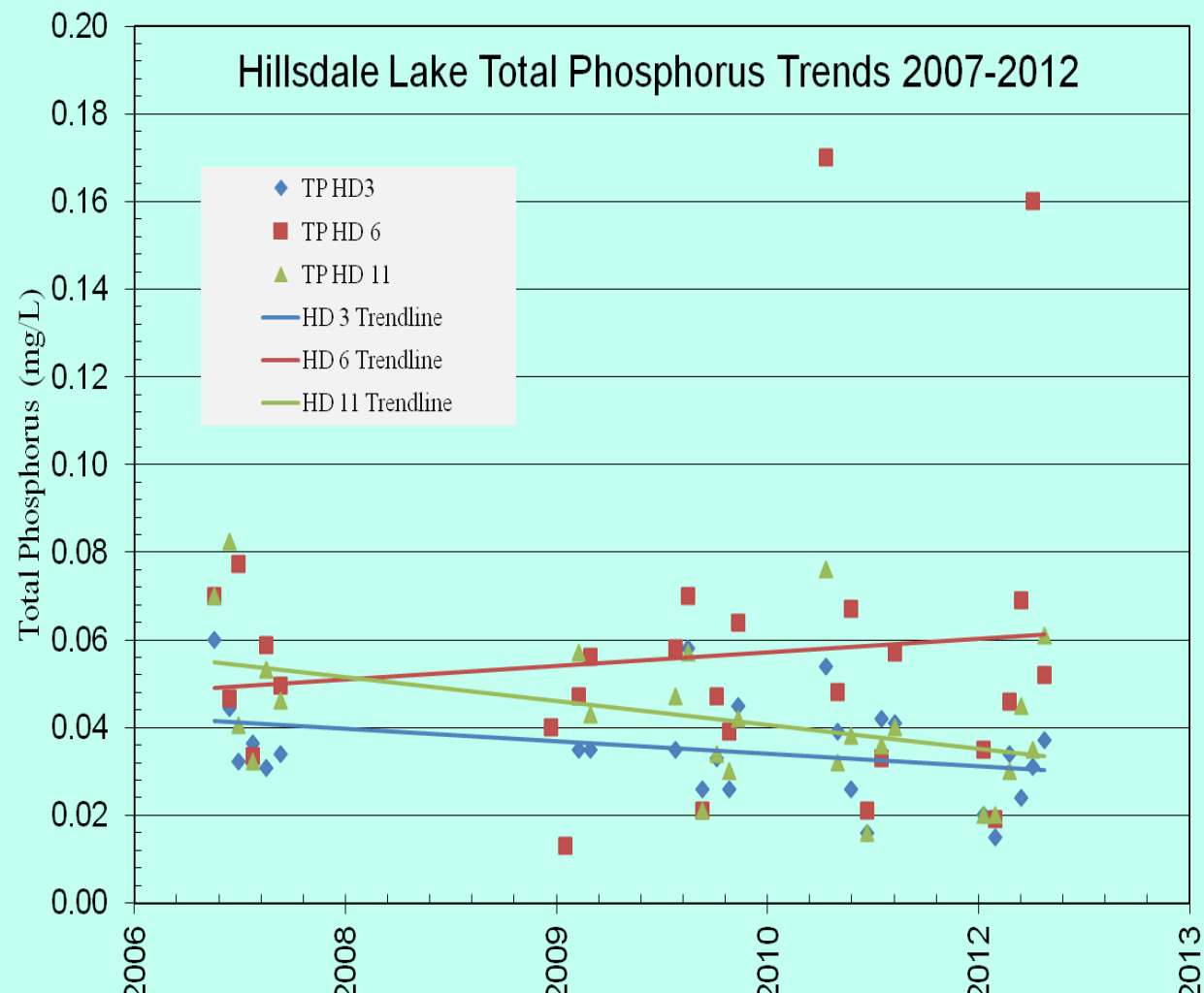
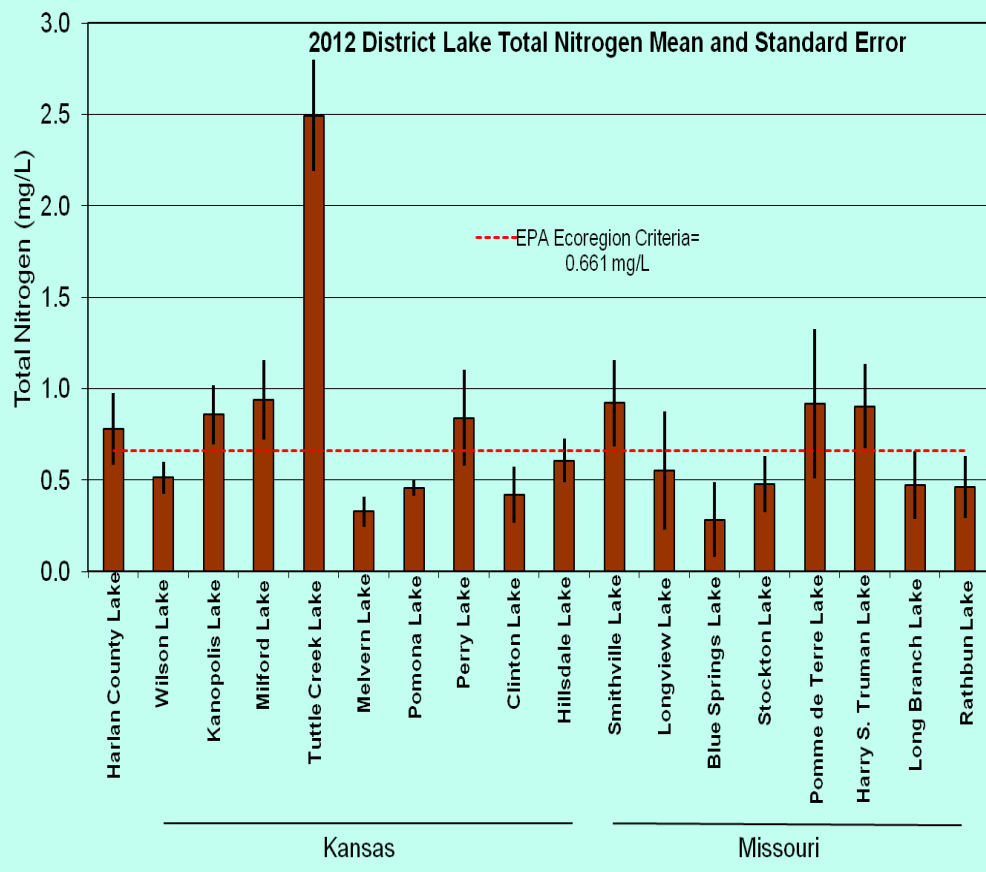
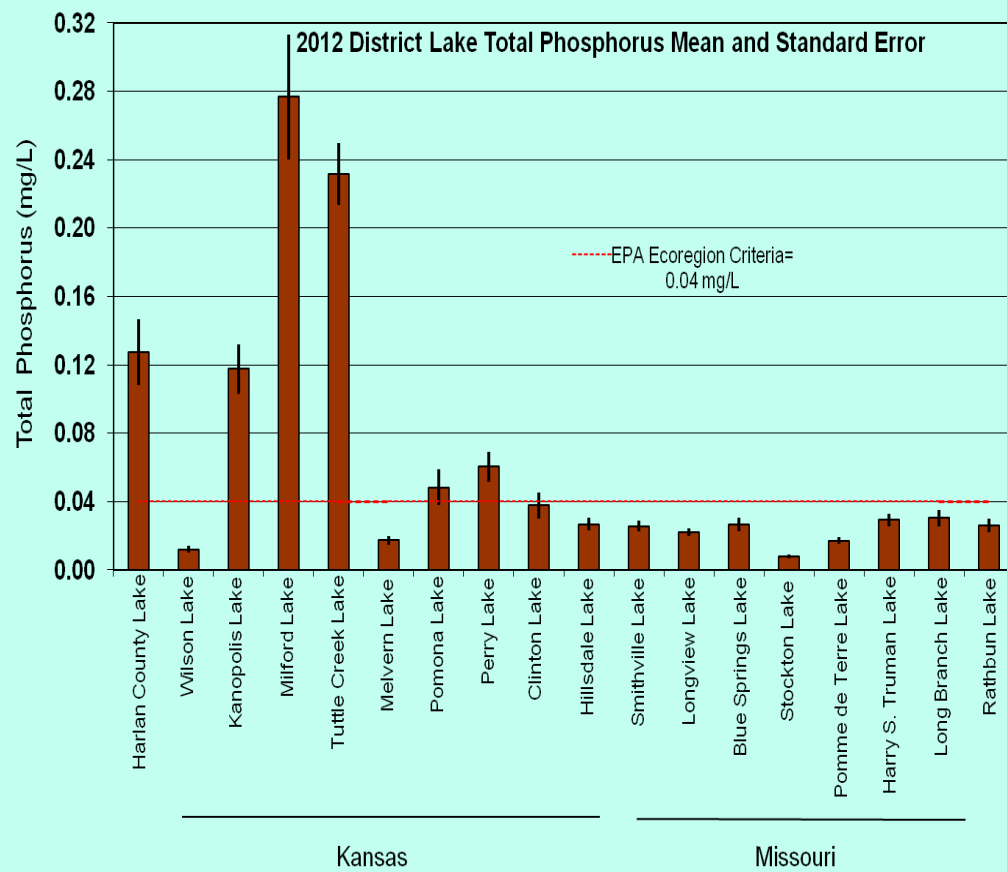


Hillsdale Lake:

- Built on Big Bull Creek 29.1 km (18.2 miles) upstream of the confluence with the Marais des Cygnes River
- **Watershed** = 144 sq miles (92,160 Acres)
- **Capacity:**
 - Flood Control: 83,000 Acre Feet (AF)/ 7,413 surface acres (SA)
 - Multipurpose: 76,300 AF / 4,575 SA / 51 miles of shoreline
- **Operating project purposes:** flood control, water quality, recreation, fish and wildlife, and water supply.
- **Avg. annual inflow** (2003-2012)=84,462 AF; **2012 inflow**= 22,774 AF
- **Water Quality** at Hillsdale Lake in 2012 showed improvements and reduced nutrient concentration, but exceeded KS State WQ Standards for designated use for supporting aquatic life at site HD-3 during September sampling due to low dissolved oxygen. There was adequate dissolved oxygen at all other lake sites.

Nutrient Enrichment

Nutrients (i.e. phosphorus and nitrogen) are essential for aquatic life and are the primary factor driving fish and aquatic plant growth rates and productivity. Excess nutrients from urban, agricultural or natural sources increases the natural aging or eutrophication process in lakes. This can alter plant and aquatic life in lakes and water bodies, cause algal blooms, create low dissolved oxygen that affect fish survival, and lead to taste and odor issues in drinking water. Hillsdale Lake is on the approved 2012 Ks 303(d) list of impaired waters due to eutrophication. EPA and KDHE are working with water quality partners, landowners to focus watershed conservation efforts on priority or target areas in the watershed to reduce nutrient and sediment runoff. This approach is designed to improve water quality and reduce designated impairments at Hillsdale Lake. In 2012, Hillsdale Lake was below average for total nitrogen and total phosphorus compared to other Kansas City District Lake. Average TP and TN measured at the dam site of Hillsdale Lake was below EPA ecoregion recommended criteria while TN exceeded recommendations. Standard error bars in the graphs below illustrate the variation in sample results from each site in 2012.

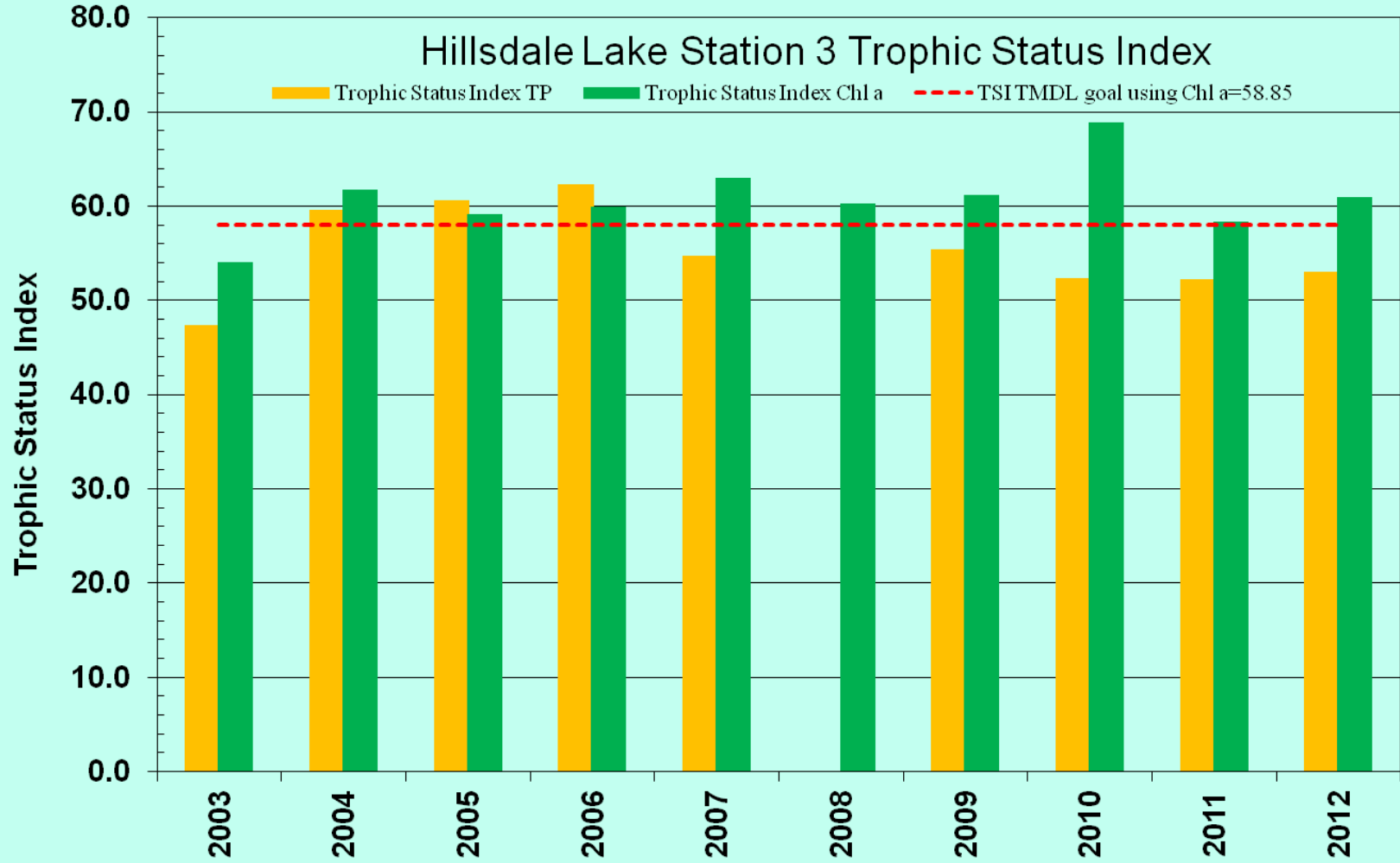


The **US Army Corps of Engineers** (USACE) Water Quality Program collects monthly water samples at Hillsdale Lake* from April through September. These figures present data collected between 2003-2012 from lake sites (#3, 6, 11), and the outflow (#2) below the dam. Thirty-four chemical, physical and biological parameters are measured to evaluate water quality. USACE uses this data to describe water quality history, conditions and changes from the inflow streams, within the main lake, and outflow focusing on eutrophication, nutrients, sediment, herbicides, metals, and contaminants.

*Note: The term “lake” is substituted for technically correct “reservoir” throughout this document for consistency.

Trophic Status Index

Trophic Status Index is a calculation based on average summer chlorophyll a from algae, total phosphorous, or secchi measurements. It is used to describe eutrophication as related to the KS 303(d) impaired waters list. EPA has worked with water quality partners to develop Total Maximum Daily Loads (TMDL) to regulate nutrient enrichment to keep Hillsdale Lake water quality acceptable for recreational, aquatic life, drinking, and industrial needs. Hillsdale TSI values calculated using chlorophyll are typically near the TMDL and classified Hillsdale as eutrophic. TSI values of less than 59 are the goal.

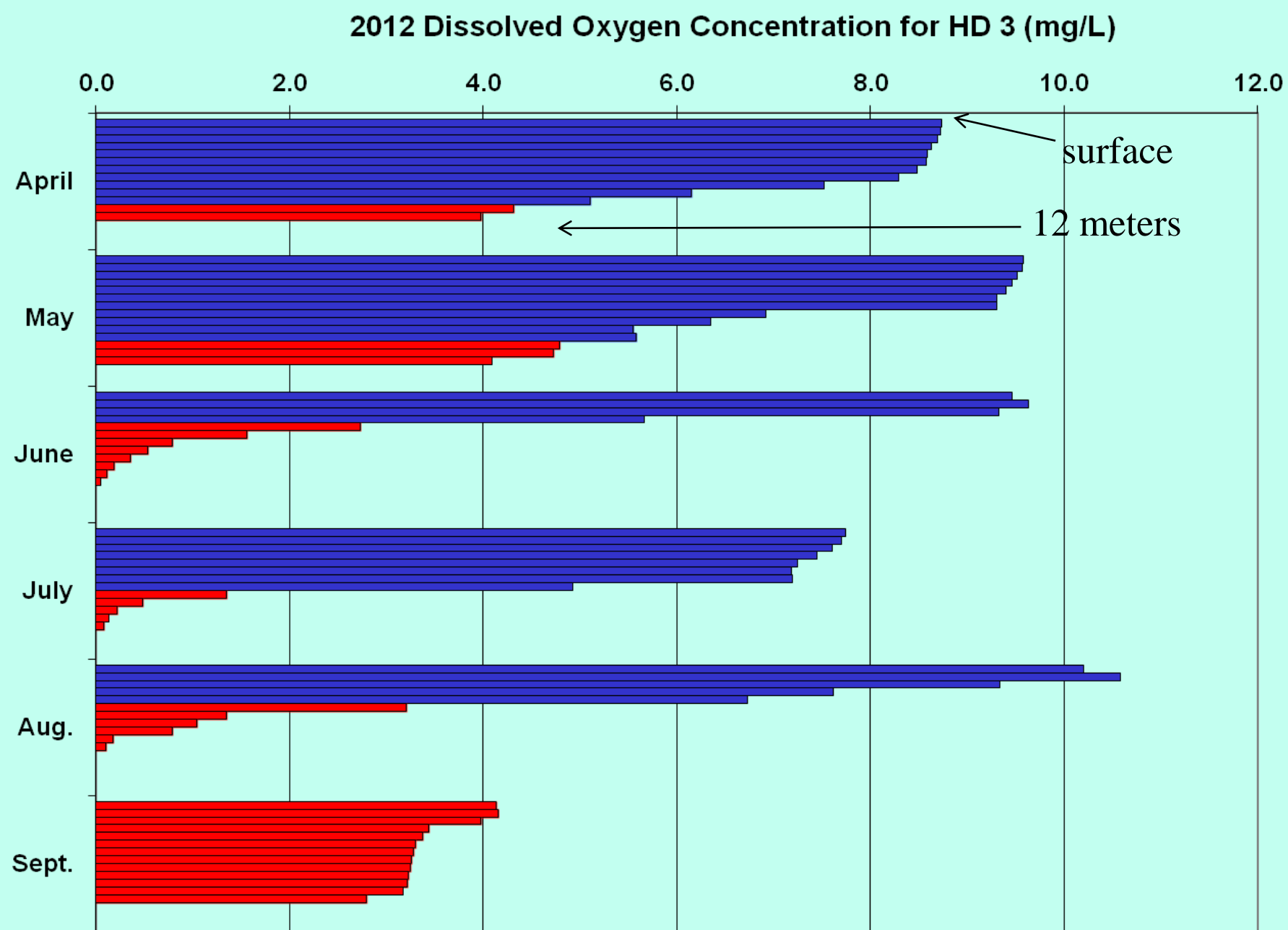


Total Phosphorus

Total phosphorus (TP) median values from 2012 Hillsdale Lake were near EPA ecoregion recommended criteria (0.04 mg/L). From 2007-2012, TP concentrations measured at all sites show significant improvements when comparing annual medians or means. Trend analysis of lake sites highlights reductions in TP over time all sites except HD-6 which is impacted by a few very high TP measurements. Median TP at all Hillsdale Lake sites are in the moderate to high range of biological productivity leading to high algae populations and rapid fish growth as indicated by TP, chlorophyll and secchi measurements in the low end of the eutrophic classification designation. Minor blue green algae bloom have occurred infrequently at Hillsdale as recently as 2011, but conditions (i.e. nitrogen:phosphorus ratio, turbidity, lake turnover rate) tend to favor beneficial green algae species over toxic blue green species.

Dissolved Oxygen

Dissolved oxygen (D.O.) is an important factor in aquatic species location, growth, and ultimately survival in lakes. Some lakes undergo a process called stratification or develop layers based on temperature and oxygen. This process begins in late spring, remains throughout the summer, and breaks apart (de-stratifies or ‘turns over’) in the fall. The figure below shows dissolved oxygen measured in the water column in one-meter intervals (e.g. each row in each month represents one meter of depth) from April through September at the dam (HD3). Hillsdale Lake typically stratifies during summer months and lack of adequate (5 mg/L) dissolved oxygen can stress fish. In 2012, Hillsdale Lake stratification was apparent June through August. During this period, the top 4 meters of Hillsdale Lake had sufficient oxygen. In September, dissolved oxygen concentrations were below the 5 mg/L threshold for surface water at all depths, but signs of fish stress was not observed or reported. Dissolved oxygen levels were locally affected by algal population dynamics at HD-3 and were as high as 9 mg/L at HD-6 and HD-11.



Water Quality Concerns:

- Eutrophication
- Dissolved Oxygen-shallow depth of stratification



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